EVALUATION OF AMENDED TRANSPLANT MIXES FOR FRUIT AND VEGETABLE PRODUCTION

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Producers of fresh market fruits and vegetables including tomato, pepper, and strawberry utilize production systems that are highly dependent upon methyl bromide soil fumigation. Florida is the nations largest producer of fresh market tomatoes and peppers and accounts for 25% of the total methyl bromide consumption in the U.S. (EPA, 1997). Other pesticides available to vegetable growers are being reevaluated because of possible threats to groundwater, food safety, and/or endangered species. Solutions to pest management issues in the absence of methyl bromide may best be sought in more sustainable production practices that do not rely heavily on chemicals whose future on the market is uncertain.

Development of integrated systems that employ use of reduced-risk chemicals, resistant cultivars, crop rotation, soil amendments, and biocontrol agents may ultimately provide acceptable levels of protection. Although transportation and field application of organic amendments is not practicle for large-scale vegetable production, there are some amendments such as chitin that, when applied at low rates, enhance plant growth and/or induce plant defense mechanisms. For these types of amendments and plant growth enhancing microorganisms such as plant-growth promoting rhizobacteria (PGPR), the ideal delivery system for use on transplanted vegetables is in the transplant plug mix. Free from competition in the pathogen-free transplant mix, the microbial agents have an advantage that allows them to colonize the host root system. This technology is also compatible with chemical soil fumigants, or in organic production systems.

A focused collaborative effort to develop a transplant medium that would improve plant growth and survival, increase resistance or tolerance to pathogens, and improve yield was undertaken which included scientists in industry, academia, and government. In collaboration with Gustafson LLC, Auburn University, USDA-ARS, and the University of Florida have worked to develop and evaluate combinations of organic amendments and PGPR. Research at Auburn previously established that the organic amendment chitin reduced disease caused by root-knot nematodes and that certain gram + bacteria isolated from soil increased plant growth and reduced the incidence of several diseases. Mechanisms for the beneficial effects attributed to PGPR indicated that increased plant growth can be attributed to shifts in the microbial ecology of the rhizosphere, production of iron chelating siderophores, antibiotics, and hydrogen cyanide. While some PGPR strains exhibit antibiosis and affect pathogens directly, other strains control disease by

mechanisms that do not involve production of toxic compounds. These mechanisms include substrate or site competition, and induced resistance in the host which results in increases in defense related compounds referred to as PGPR-mediated induced systemic resistance.

Bacillus subtilis has been the most successful PGPR exhibiting disease-reducing capabilities. Marketed commercially as Kodiak® (Gustafson LLC, Dallas, TX) *B. subtilis* is well known for its antibiotic production capabilities. Kodiak® seed and root inoculants have achieved excellent yield increases on numerous large-seeded vegetables, and in cauliflower by treating seed or plug mixes. *Bacillus* products also are known to increase root mass and suppress diseases caused by *Fusarium* and *Rhizoctonia*. These products have been applied to millions of acres of field crops; yet their experimental use with transplanted crops has been very limited.

Field trials were conducted over the past three years in Alabama and Florida to evaluate tomato, pepper, strawberry, cantaloupe, watermelon, and cucumber transplants grown in mixes amended with formulations of PGPR and organic compounds. Treatments were assessed for growth and vigor, incidence of diseases caused by soilborne pathogens and root-knot nematodes, and yield. Transplant vigor in all crops tested was significantly increased in the amended mixes. The formulation components (primarily chitin) contributed to enhanced plant growth, however, a substantial, often synergistic increase in plant growth occurred with inclusion of combinations of bacterial isolates. These isolates reduced galling by root-knot nematode on pepper, increased yield and grade of tomato and pepper, and increased yield of strawberry. Field evaluation of amended transplant mixes is continuing this year with increased grower cooperation.

Biocontrol agents alone will not replace methyl bromide. The use of biocontrol agents in integrated management systems, either as seed and/or plug treatments, can significantly contribute to improved levels of crop production and are easily incorporated into existing production systems including a variety of complementary pest management strategies. Transplant mixes amended with PGPR can enhance growth of many important transplanted fruits and vegetables, reduce application of fertilizers in the greenhouse, reduce damage caused by some pathogens, and enhance yield.